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# SILVICULTURE OF LODGEPOLE PINE

## IN THE CENTRAL ROCKY MOUNTAINS

by Wayne D. Shepperd and Robert R. Alexander

USDA Forest Service
Rocky Mountain Forest And Range Experiment Station
FORT COLLINS, COLORADO

RM-TT-3

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# PREFACE

Lodgepole pine (*Pinus contorta* Dougl.) grows on a wide range of sites in the Central Rockies, occurring either in pure stands or with other species. This site and stand diversity, combined with the relative intolerance of the species, variation in cone serotiny, and susceptibility to dwarf mistletoe and insect attack, complicate the silviculture and management of this species. Considerations for scenic, recreation, and wildlife resources further increase the complexity of management of lodgepole pine. It is important, therefore, that silvicultural practitioners and forest managers understand the interrelationship of these factors in order to choose the proper silvicultural treatment for a given stand.

This booklet and the accompanying slide-tape presentation are designed to provide a concise summary of the ecology and silvicultural practices available for use in lodgepole pine forests in the Central Rockies. Please keep this booklet as a handy reference to help you recall the subjects presented in the talks and also locate additional literature in which you can find the original research covering the topics. You can obtain copies of the references cited by contacting the WESTFORNET library network at 240 West Prospect, Fort Collins, CO 80526.

This slide-tape presentation has been distributed to all National Forests in the Central Rocky Mountain area which manage the lodgepole pine type. Information concerning the purchase of additional copies of this or other slide-tape and booklet sets in this series can be obtained from the USDA Forest Service Rocky Mountain and Southwestern Regional Offices, or by writing:

Public Affairs Officer
USDA Forest Service
Rocky Mountain Forest and Range Experiment Station
240 West Prospect
Fort Collins, CO 80526

Other titles in this series include the following:

Overview to Silvicultural Systems in the Central Rocky Mountains (RM-TT-1)

Silviculture of Spruce-Fir Forests in the Central Rocky Mountains (RM-TT-2)

Silviculture of Ponderosa Pine in the Central & Southern Rockies. (RM-TT-4)

February 1983

# Silviculture of Lodgepole Pine in the Central Rockies


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USDA Forest Service
RM-TT-3


[1]*Headquarters is in Fort Collins, in cooperation with Colorado State University.*


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# SILVICS OF LODGEPOLE PINE

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**1 . . . 2 . . . 3 . . .** (musical interlude)

**4.** A familiar sight to visitors to the Central Rockies are the thick, straight stands of lodgepole pine, often extending for miles in pure stands. Its tall, straight poles were once used by early Indians to build their lodges and teepees.

**5.** It now provides for man the second largest timber resource in the Central Rockies. It's found. . .

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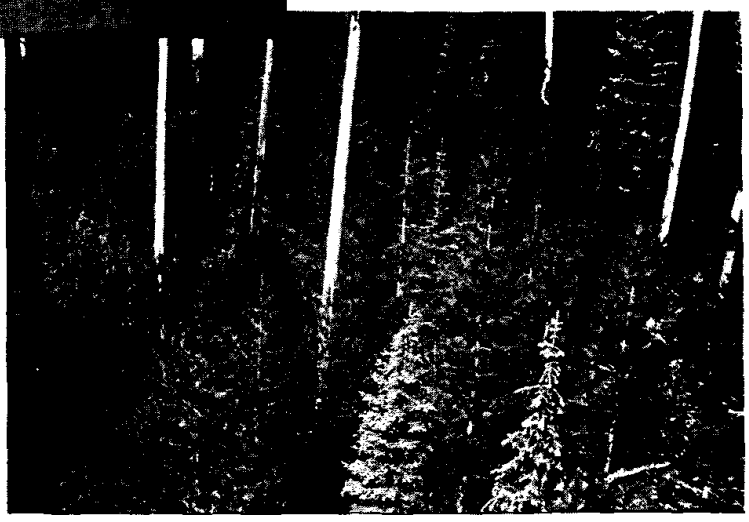

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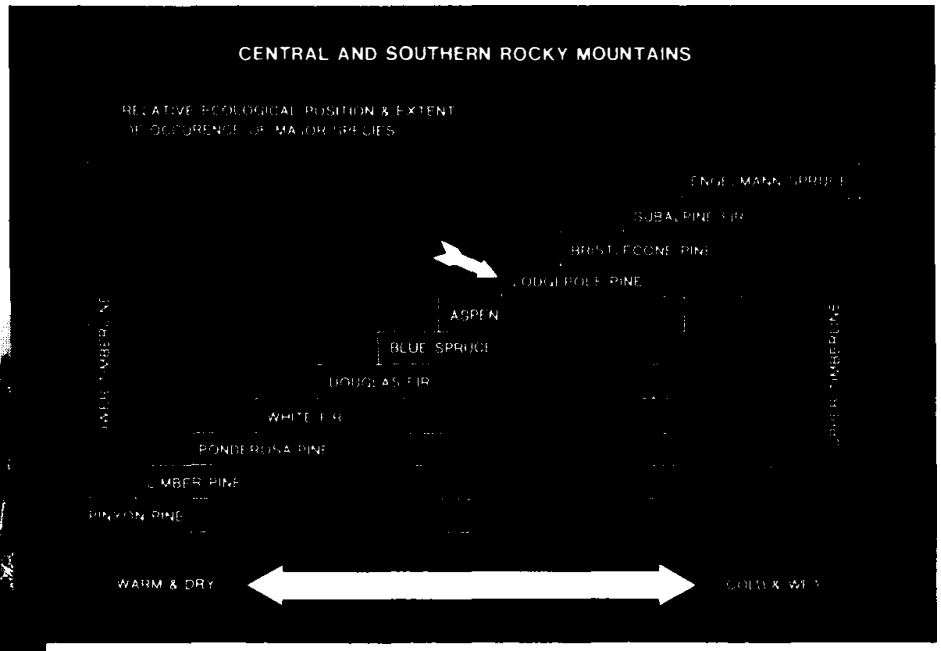


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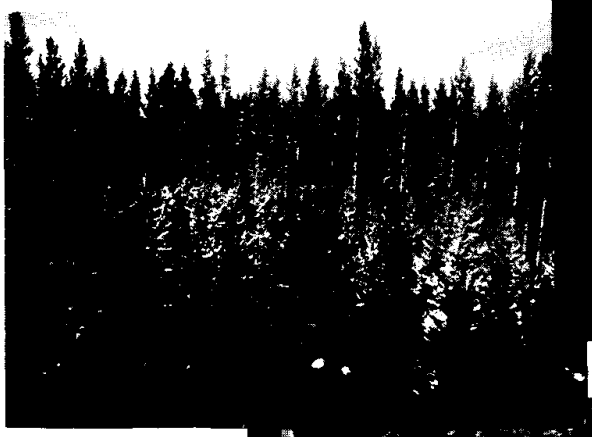

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**6.** . . . lower in elevation than the harsher environment of spruce-fir forests, but occasionally overlaps into the higher zone. The climate is warmer and drier than in the higher spruce-fir zone, but there still are extreme fluctuations in its climate.

**7.** Most precipitation in lodgepole pine forests comes as snow during the long winters, but during the growing season when the trees really need moisture, it can be quite dry (Alexander 1974).

**8.** These forests provide timber and other forest related products. But lodgepole forests also provide habitat for many wildlife species . . .

**9.** . . . and are important recreational and scenic areas.

**10.** Snowfall in these forests produces water for domestic, commercial, and agricultural use.

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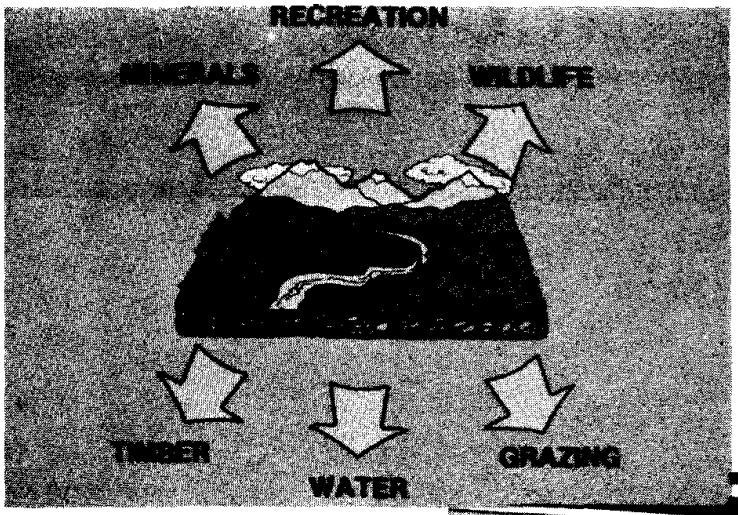


**11.** As with other timber types in the Central Rockies, forest managers who work with lodgepole pine forests must meet increased demands for limited forest resources without serious damage to the environment.

**12.** This program is one of a series designed to help you manage each of the significant timber types in the central Rockies. In the introductory talk, we've covered many basic generalities. Now, let's take a look at specific details that apply to the . . .

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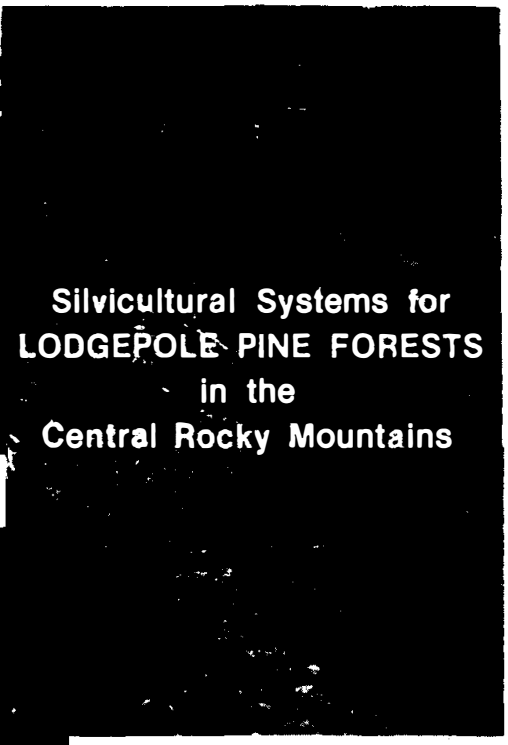


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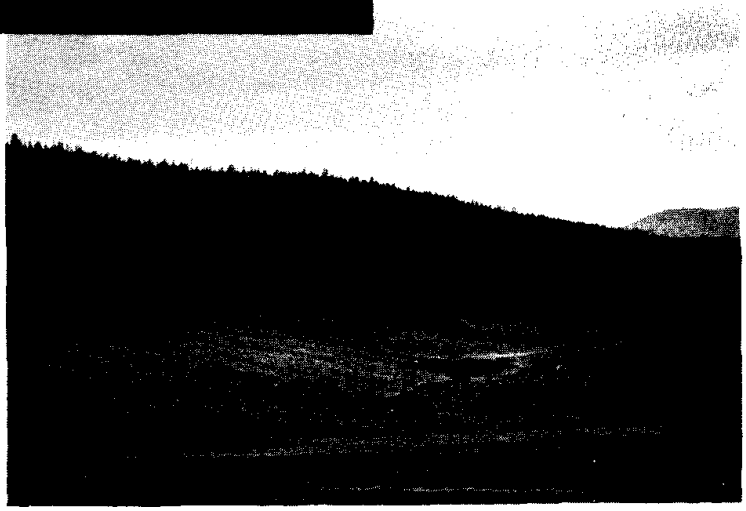
Rocky Mountain Forest & Range Experiment Station

14

**13.** . . . silviculture of lodgepole pine in the Central Rockies.

**15.** Lodgepole pine forests cover extensive areas between 7,500 and 10,000 feet elevation in Colorado and Wyoming. However, maximum development of this species is found in the upper montane and lower subalpine zones on south and west slopes between 8,500 and 10,000 feet (Alexander 1974).



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# STAND CONDITIONS

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**16.** Lodgepole pine forests in the Central Rockies are usually thought of as large continuous masses of pure, single-storied stands.

**17.** But naturally occurring, uniform stands are found only where favorable seed, climatic, and fire conditions combine to produce a large number of trees (Lexen 1949).

**18.** Sometimes under these conditions, lodgepole develops into overly dense, stagnated, even-aged stands.

**19.** Where conditions are less favorable, lodgepole either develops into stands with irregular spacing, . . .

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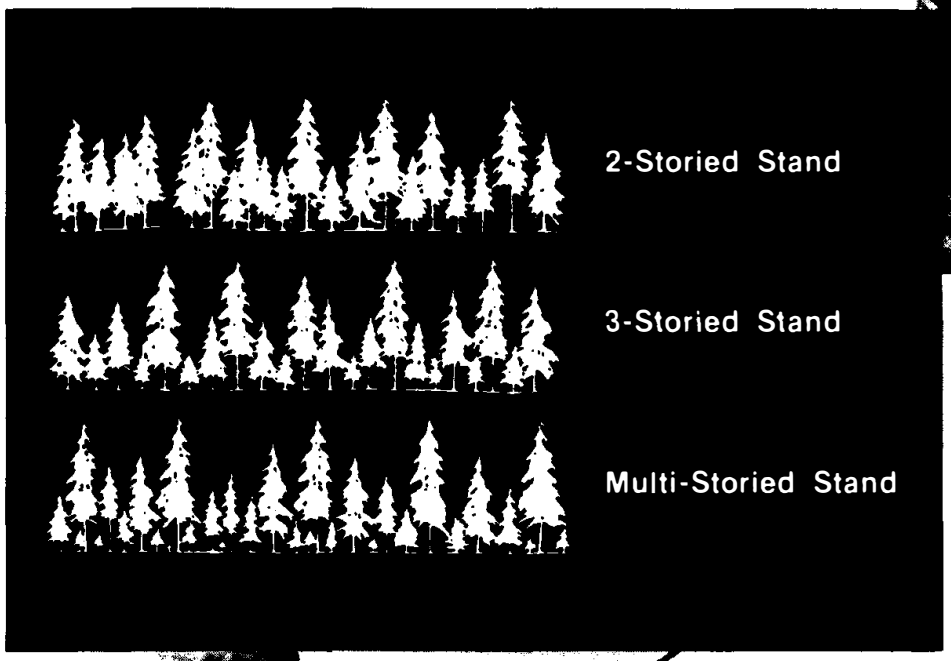
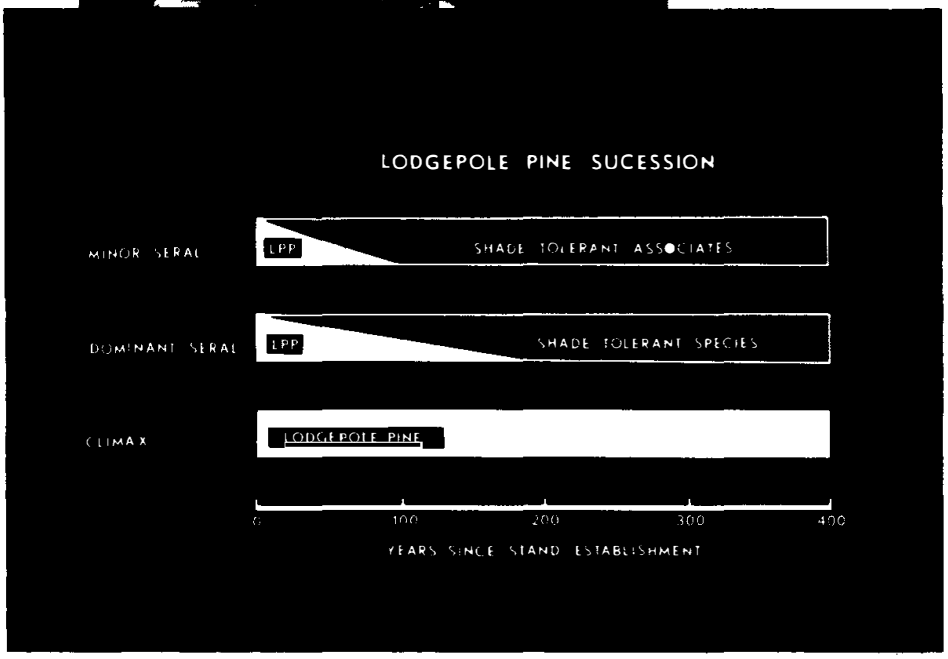



**20.** . . . or into stands with such low density that typically limby, open-grown trees result. This characteristic has important management implications for both thinning and planting.

**21.** These low density stands may produce two, three or multistoried stands (Tackle 1955). But in multistoried stands, lodgepole occurs on habitat types where it is mixed with other species (Alexander 1974).

22

**22.** Lodgepole is an aggressive pioneer and invader. After drastic environmental changes such as fire, it is considered the initial, or seral stage in succession back to the original climax vegetation (Stahelin 1943).




**23.** Lodgepole is considered to be seral in stands that have either a mixed overstory composition or that contain significant amounts of advanced reproduction of other species. However, acreages of nearly pure pine often are the result of devastating fires that have burned so frequently that lodgepole is the exclusive species in some areas. On those sites and others, it can essentially be considered the climax species (Hoffman and Alexander 1976, Hoffman and Alexander 1980, Wirsing and Alexander 1975).

23

# DAMAGING AGENTS

## WIND

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**24.** Lodgepole is susceptible to many damaging agents. One of these that especially affects forests growing at high altitudes is wind damage.

**25.** However, susceptibility to windfall is also a function of stand condition, cutting method, soil depth and drainage, and topographic exposure (Alexander 1964, 1967, 1974). There are several topographic criteria that can help you determine the wind risk of a particular stand. For example, . . .

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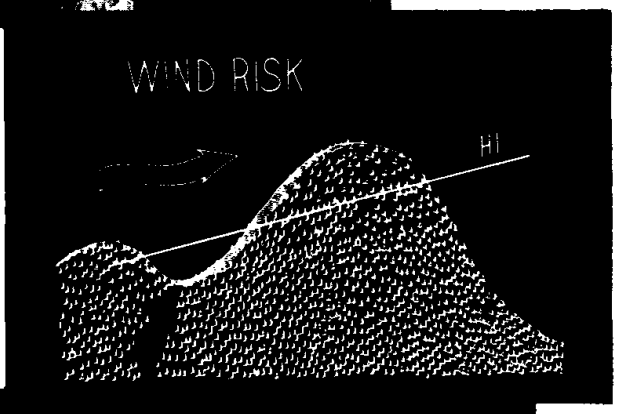
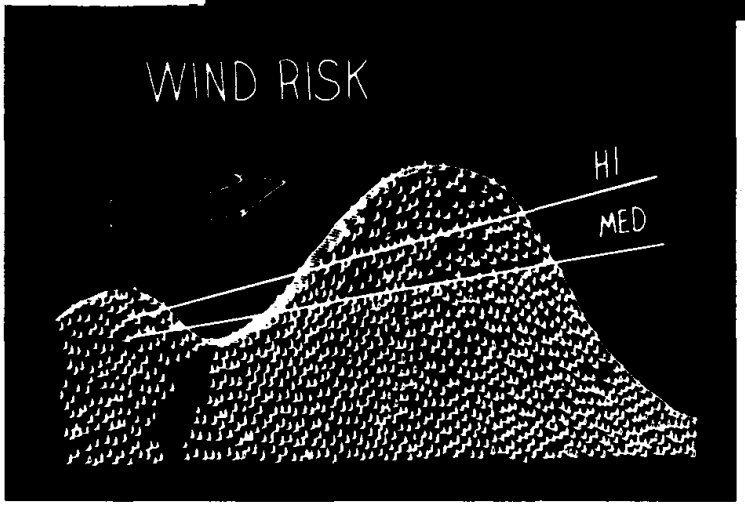



**26.** . . . in this slide, south or west faces to the left, and north or east to the right. Wind risk is high on all ridge tops. It is high on south- or west-facing upper and mid-slopes that are moderate to steep, as shown by the left side of the large mountain here.




**27.** Wind risk is usually moderate in situations at the mid-slope range, on moderate to steep slopes that face south or west but are *protected* by higher ground, such as the smaller ridge, which we see here to the left. It is moderate on steep middle slopes and upper slopes which face north or east, primarily the belt that is shown between the high line and the medium line on this slide.

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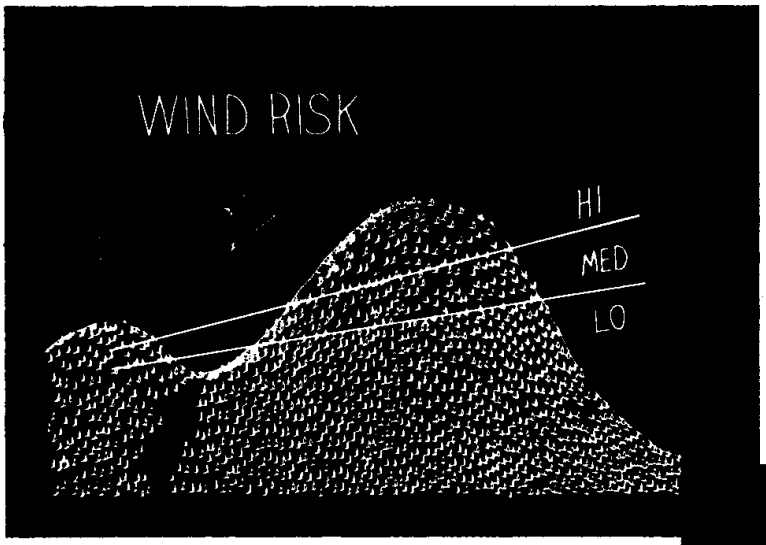


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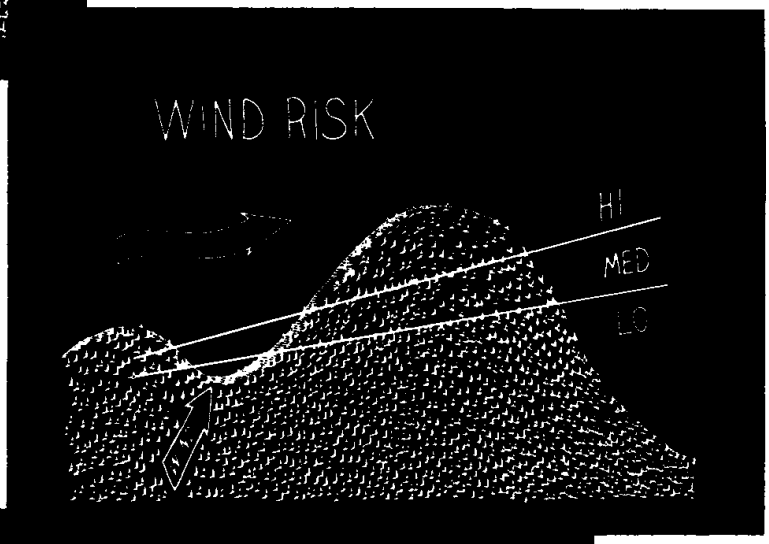


**28.** Wind risk is low, or below average in three different cases: The first is in flat areas or valley bottoms which lie at right angles to the wind; secondly on both lower slopes and gentle slopes that face north or east, as shown toward the right in this slide; and finally, on lower slopes and gentle middle slopes that face south and west, as toward the left in the slide, that are protected by higher ground close to the windward side.

**29.** Wind risk can also be high in the valley bottoms which are parallel to the wind, as shown here; and can also be high . . .

**30.** . . . in areas where wind is funneled through saddles and ridges, as shown here.

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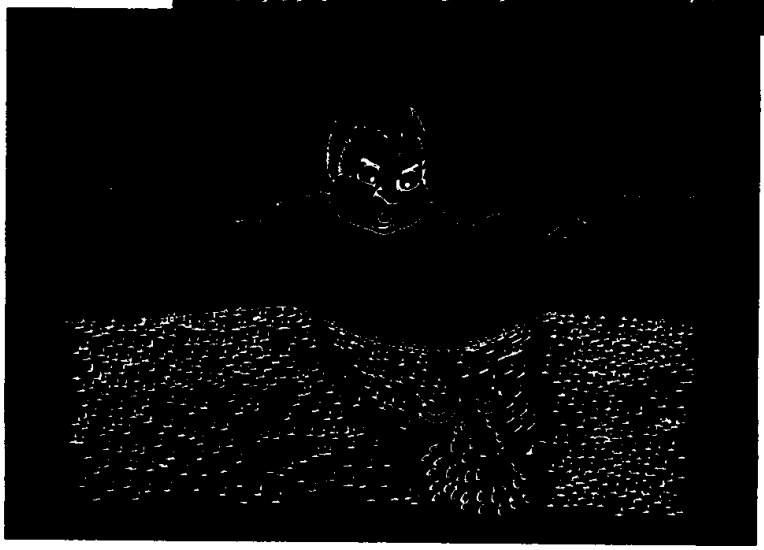

# DWARF MISTLETOE

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**31.** Windthrow is just one agent damaging lodgepole forests. Dwarf mistletoe is another. A major disease affecting lodgepole, mistletoe infects trees of all ages and may kill small trees in a short time (Hawsksworth 1965).

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**32.** Older, larger trees die more slowly, but their growth is reduced drastically. Dwarf mistletoe is most damaging in stands partially opened by cutting, mountain pine beetles, or in windfall areas. Regenerated burns or larger clearcuts seem to be least affected.

**33.** Two methods you should consider to control dwarf mistletoe are: separation of old and new stands by clearcutting, and removing trees with low market value (Scharpf and Parmeter 1978).

**34.** Inspect each stand carefully and use the six class rating system (Hawksworth 1961) to determine the severity of the infection. Using this system, individual trees are treated differently.

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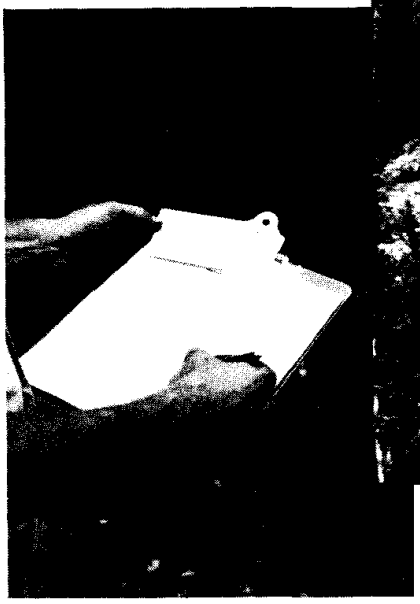

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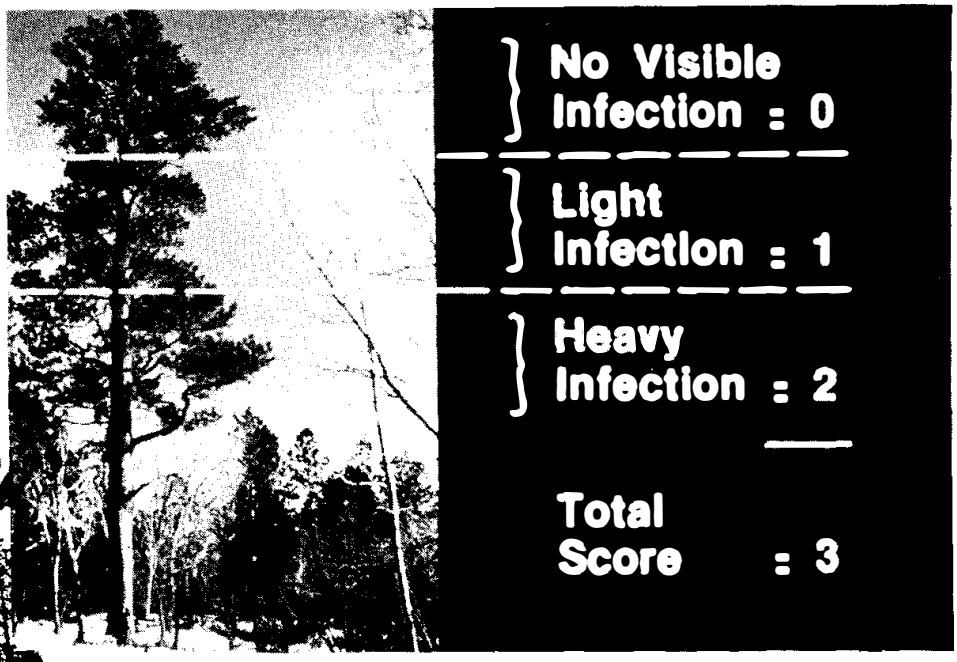


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**35.** First, divide the crown into thirds and rate each third separately. For example, if the upper third has no visible infection, its rating is zero.

**36.** If the middle third is lightly infected, then the rating is one.

**37.** A heavily infected lower third would have a rating of two.

**38.** Finally, add the ratings together to obtain an overall tree rating. An entire stand as well as individual trees can be rated by determining the percentage of trees infected in the stand. If you're interested in more details about this system, contact the Rocky Mountain Forest and Range Experiment Station in Fort Collins, CO.

**39.** In managing mistletoe-infected stands, you should avoid partial cutting in stands with a rating of two or more, and where more than 70 percent of the trees are infected.

# OTHER DISEASES

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**40.** Another common disease of lodgepole is comandra blister rust. About the only effective method for control is a sanitation salvage cut removing infected trees to reduce the rate of spread (Peterson 1962, Mielke et al. 1968).

**41.** Western red rot and associated decay fungi also cause large volume losses in old-growth timber (Hepting 1971). It appears that the impact of these diseases is reduced in young, managed stands, and that sanitation salvage is the most practical method of control.

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# INSECTS

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**42.** Bark beetles are one of the most serious insect pests in lodgepole pine (McCambridge et al. 1979). Mountain pine beetles attack mature to over mature stands.

**43.** Outbreaks may also develop in heavy blowdown . . .

**44.** . . . in trees damaged by forest fires . . .

45

46

**45.** . . . in concentrations of large logging slash . . .

**46.** . . . or in stands weakened by overcrowding and defoliating insects. Once an outbreak has reached epidemic proportions, young, vigorous trees may be killed or damaged. You can best handle outbreaks by removing attacked and susceptible trees . . .

**47.** . . . followed by spraying or burning all material. If there are numerous small diameter trees, leave them; otherwise, regenerate a new stand.

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# BIRDS AND MAMMALS

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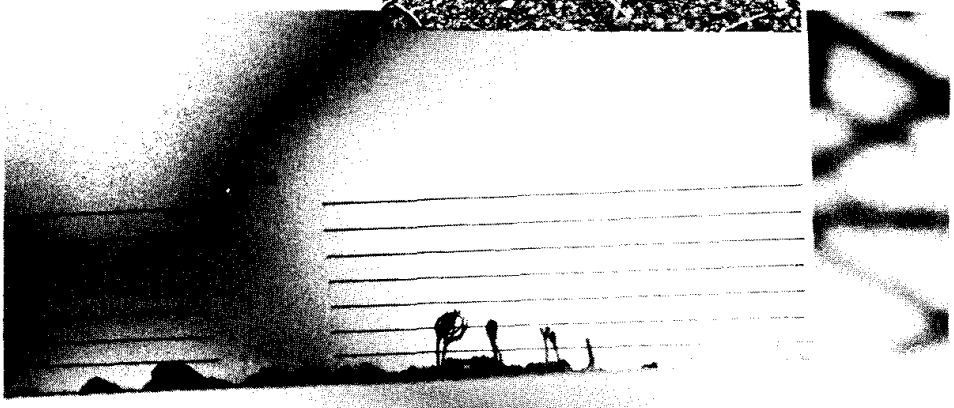

**48.** Reproduction can be limited by squirrels and other mammals which often eat large amounts of seed (Schopmeyer 1974) . . .

**49.** . . . while voles and pocket gophers damage stems and root systems (Crouch 1982).

**50.** Small birds such as juncos clip off new growth (Noble and Shepperd 1973) . . .

**51.** . . . and big game animals and sheep browse and trample young seedlings (Roe et al. 1970).

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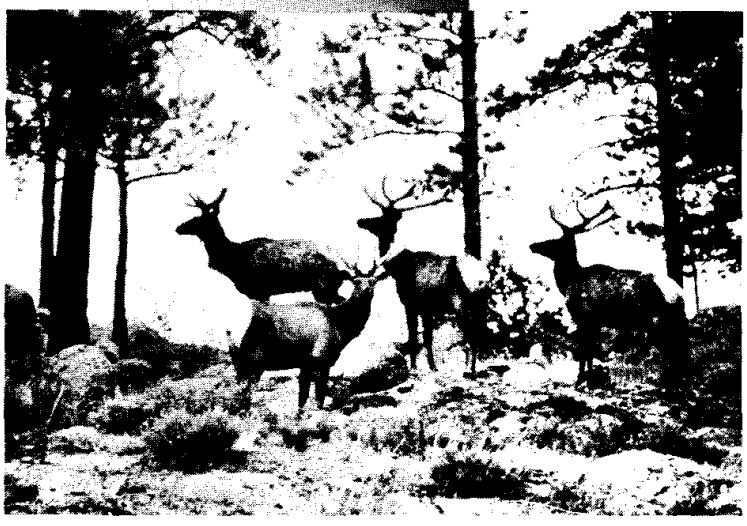

# ORGANIC MATERIALS

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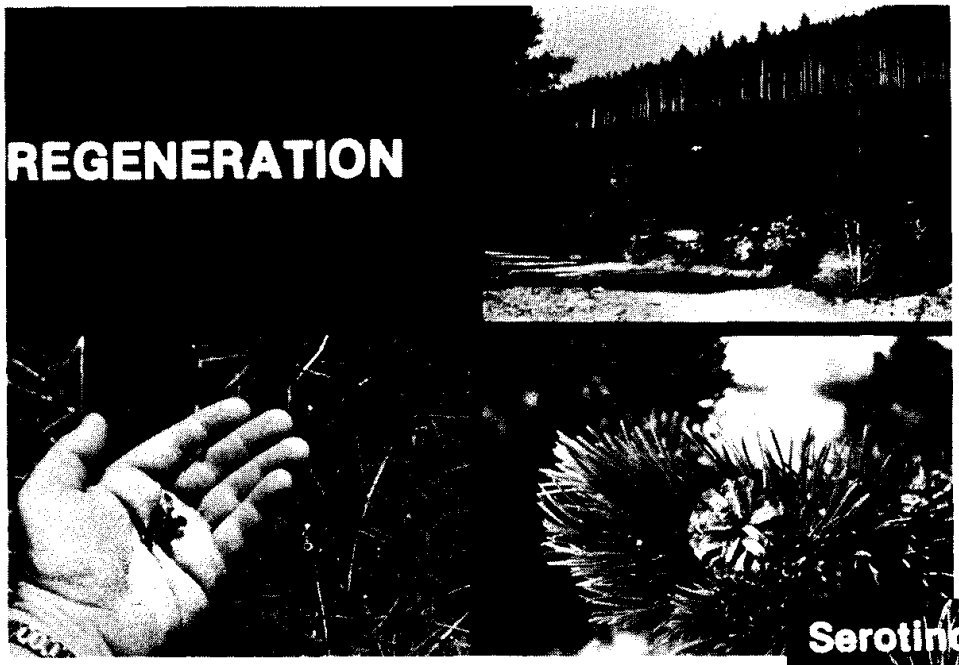
**52.** Even dense grass stands and other vegetation can kill young seedlings. Grass, if thick enough, smothers seedlings and robs them of soil moisture.

# REGENERATION




53 **53.** The regeneration characteristics of lodgepole pine is another extremely important factor to consider when developing a management prescription.

**54.** Lodgepole pine produces large seed crops every one to three years (Alexander 1974). Throughout much of the central Rocky Mountains, lodgepole pines bear an abundance of serotinous cones that remain unopened on standing trees (Lotan and Jensen 1970). However, in some areas, the cone habit is largely nonserotinous (Lotan 1967). Because the variability in cone habit greatly affects regeneration, you must examine each stand before cutting to determine cone serotiny.

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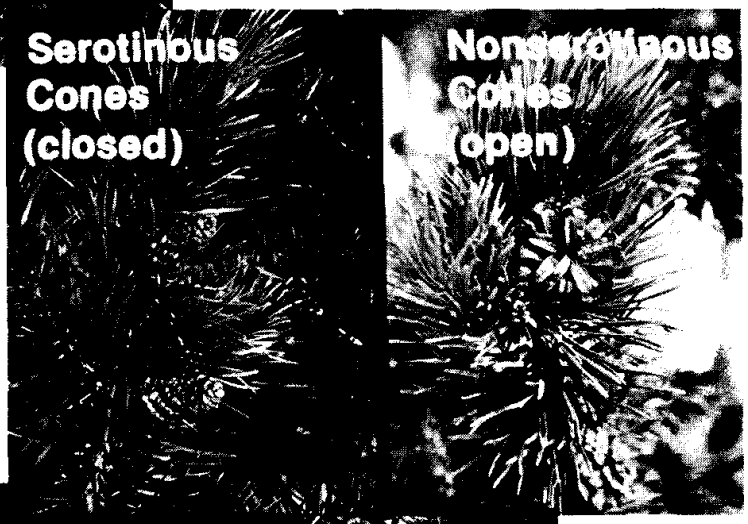
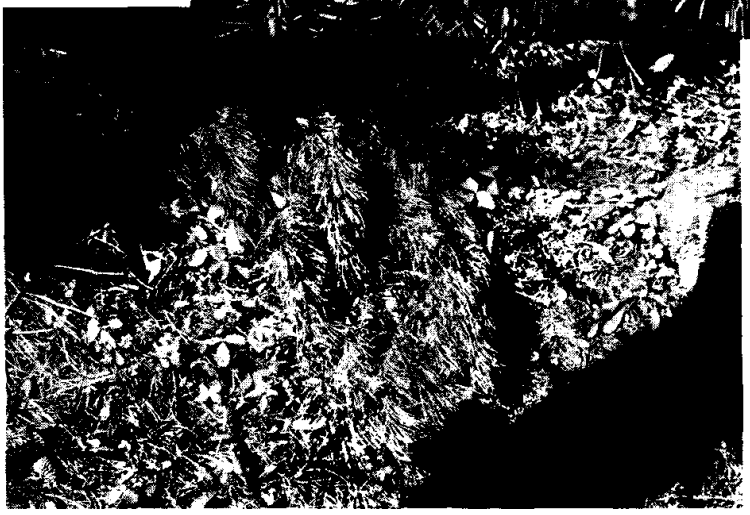



**55.** In stands with serotinous cone habit, seeds released from closed cones attached to slash and those scattered on the forest floor are the only means of seed dispersal. Maximum release from closed or serotinous cones takes place the first year after cutting. Stored seed usually is adequate for regeneration, if cone-bearing slash is carefully handled (Lotan 1964b).



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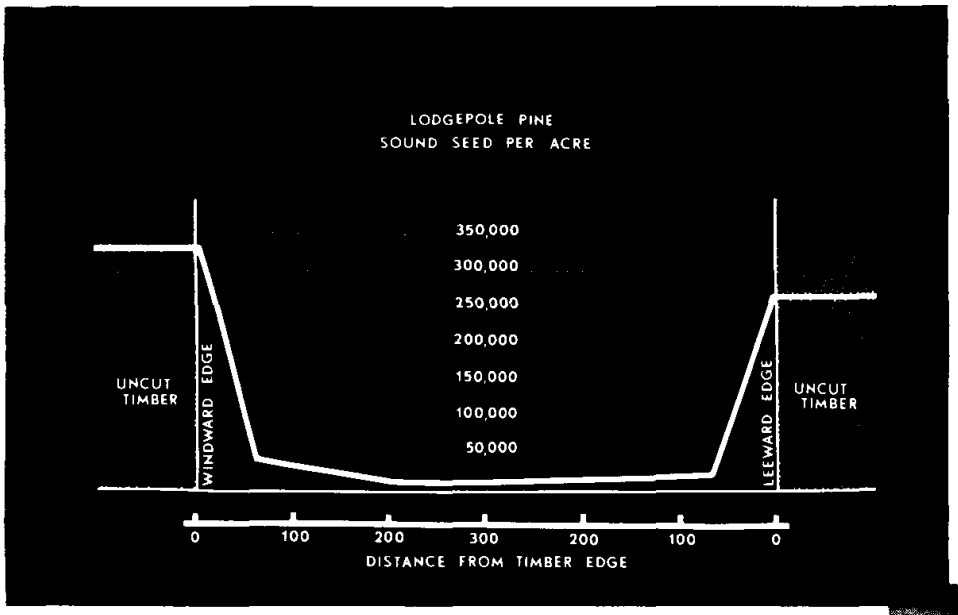


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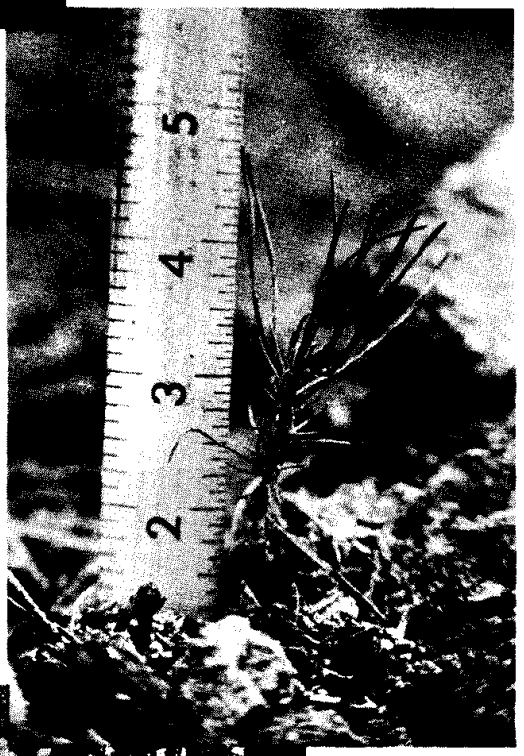

**56.** In stands with nonserotinous or open cones, seed is dispersed from standing trees. Wind carries seed to approximately four to five times tree height. Most seed falls within about 200 feet (Tackle 1964).

**57.** In either case dispersed seeds that survive the long cold winters germinate in spring or early summer following snowmelt (Lotan 1964a). Germination and survival of all conifers is best on moist, mineral-soil seedbeds.

**58.** Dry periods in spring and early summer limit seedling survival but usually don't kill seedlings except on severe sites. Fall moisture has less effect on seedling growth. Pines are usually considered to be well adapted to establishment in the open. However, light overstory shade does improve the survival and early growth of pines by lowering daytime temperature, thereby reducing water losses from seedlings and soil (Alexander 1974).

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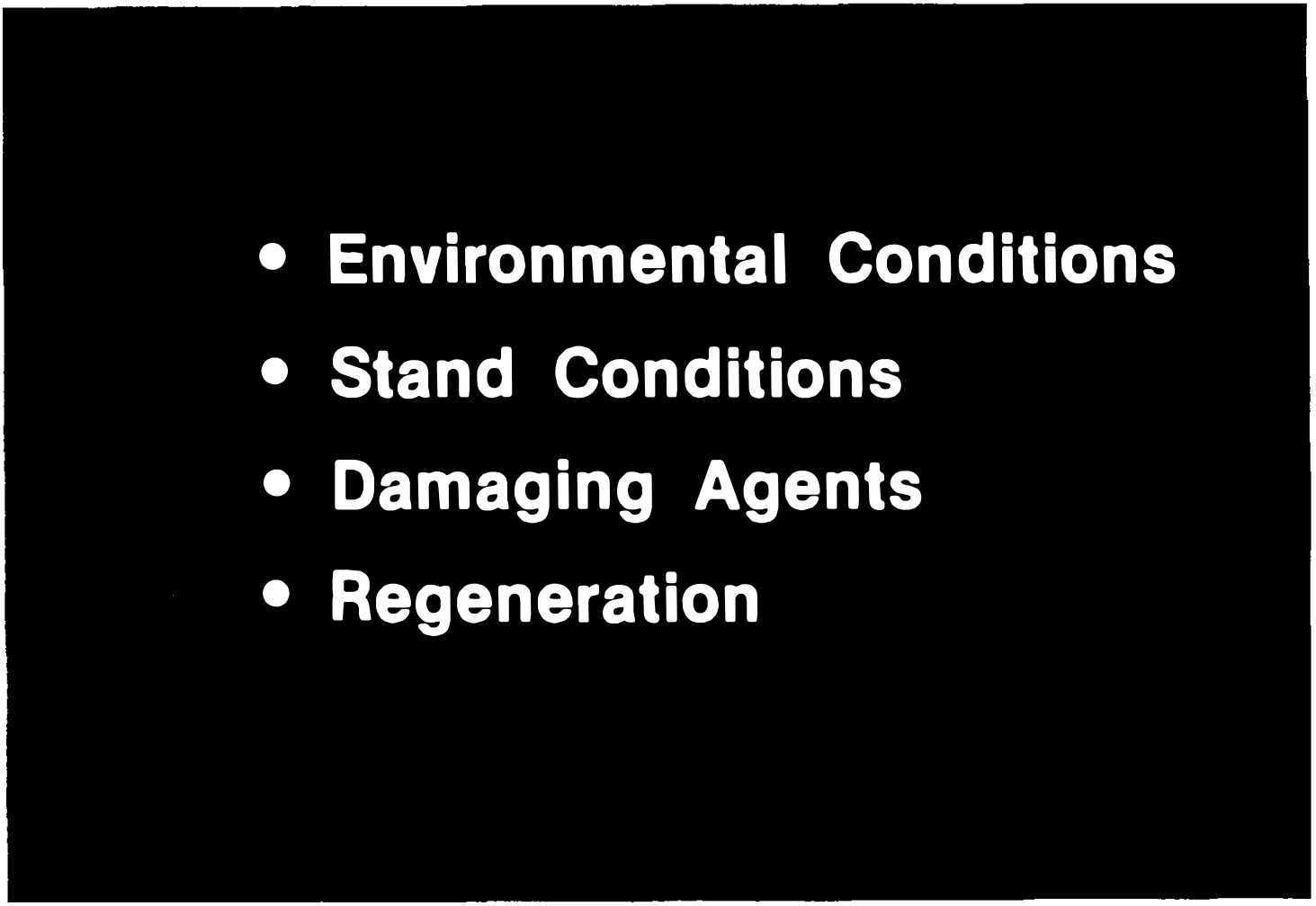
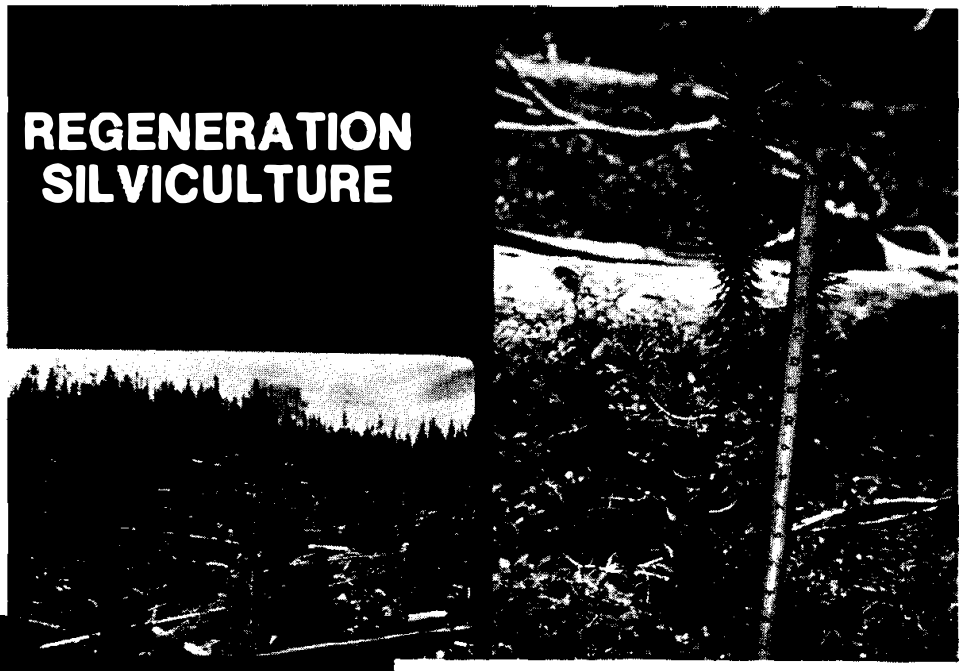



**59.** Up to this point, we've discussed environmental conditions, stand conditions, damaging agents and regeneration factors that affect lodgepole pine management. You must consider each of these four factors in selecting . . .

# REGENERATION SILVICULTURE

**60.** . . . the cutting methods you'll use to successfully regenerate a lodgepole pine stand.

**61.** Recommended cutting methods for old-growth lodgepole pine forests include clearcutting, shelterwood and group selection cuts (Alexander 1974, 1975).

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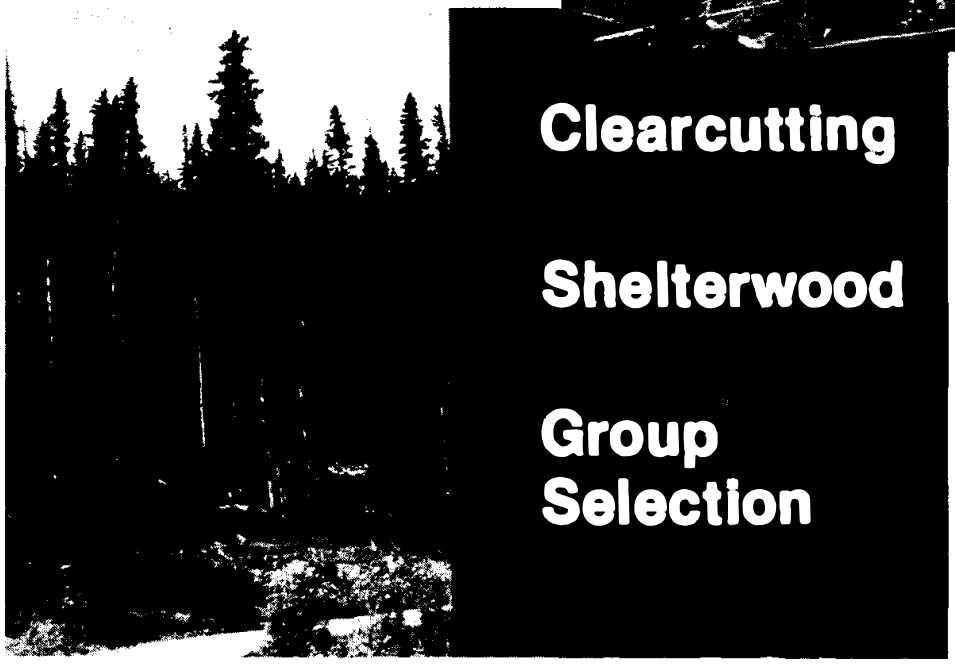


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# CLEARCUTTING

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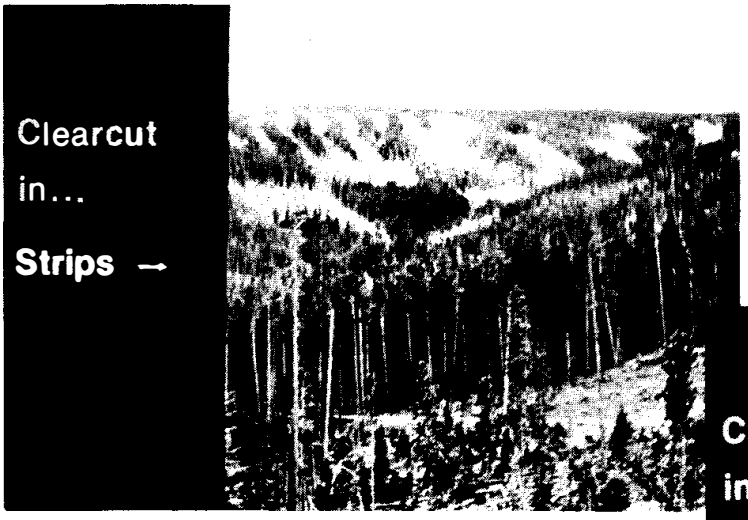
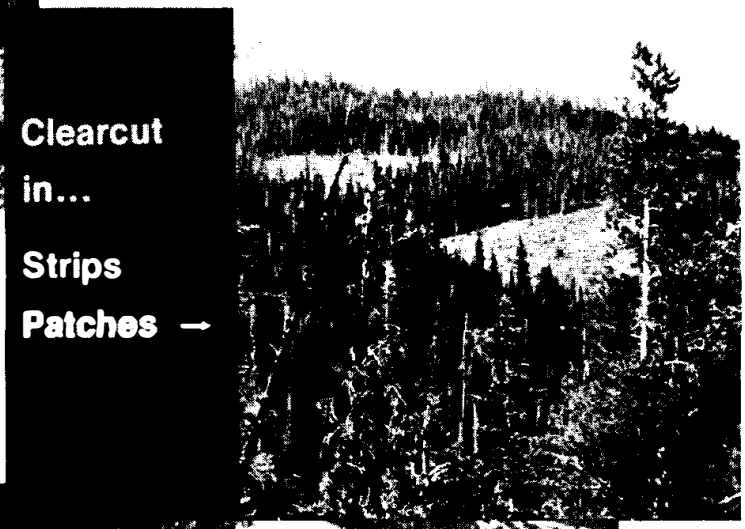



**62.** In lodgepole stands, clearcutting can be made in strips, . . .

**63.** . . . patches, . . .

**64.** . . . or blocks. Before cutting, carefully look at the condition of the seedbed, and determine if the cone habit is open or closed.

63




**65.** In stands with serotinous or closed cones, you'll have more flexibility in the size and shape of openings.

**66.** Since serotinous lodgepole pine clearcut areas are regenerated from seed dispersed from slash left after logging, design your prescription so that cutting unit layout, slash disposal and seedbed treatment aid seed dispersal and promote seedling survival. Normally, natural regeneration is a one time opportunity.

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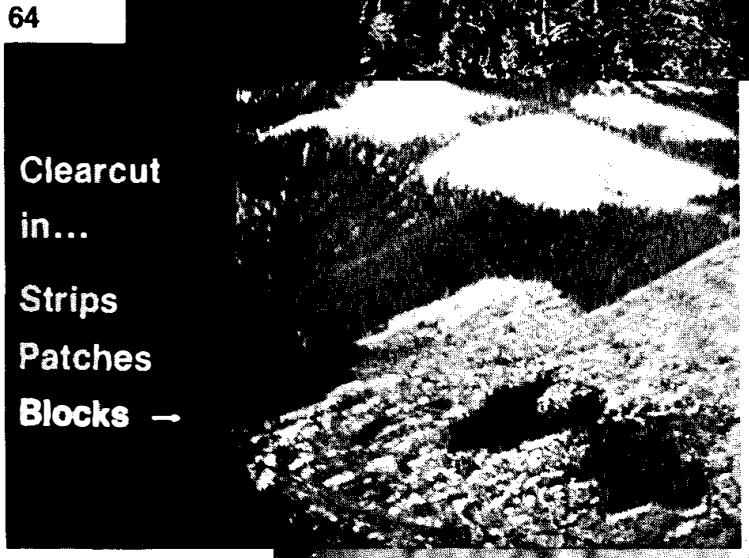


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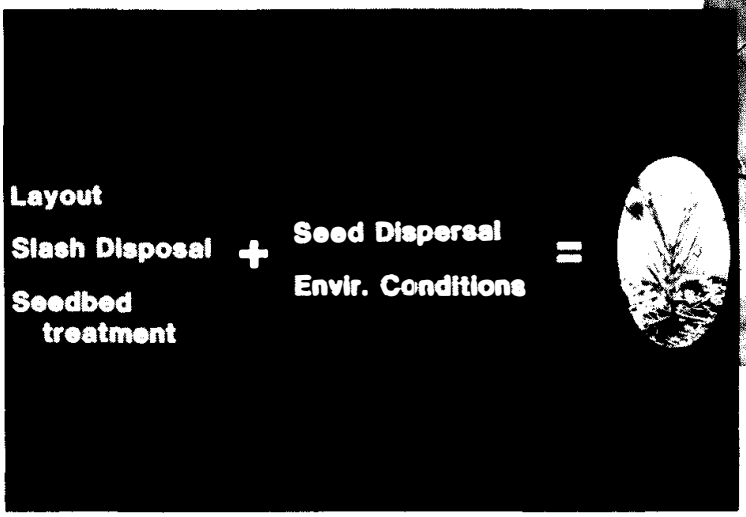

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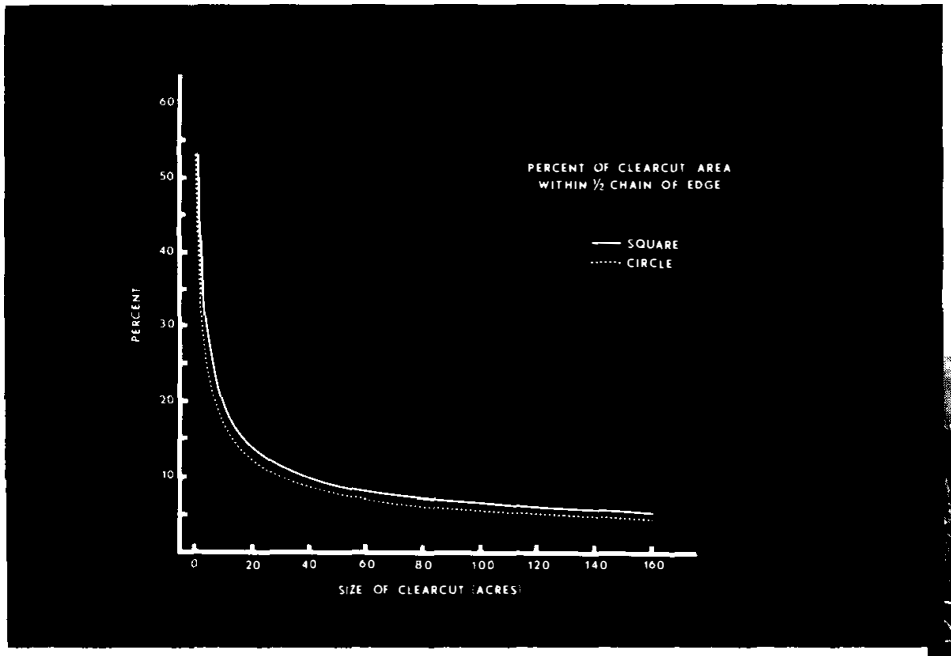


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LODGEPOLE PINE

Clearcut

| Serotinous | Non-Serotinous |
|---|---|
| <40 Acre Units | 4-5 x Tree Ht. |

**67.** However, there is no advantage to cutting openings larger than 30 to 40 acres, even for stands infected with dwarf mistletoe. Smaller openings — 10 to 20 acres — provide an additional seed source from trees standing around the perimeter of the opening.

**68.** In stands with nonserotinous open cones, or of intermediate cone habit, cutting units must be designed so that either seed from surrounding timber margins reach all parts of the opening . . .

**69.** . . . or the cut is made in a good seed year after cones are mature and seed is shed.

**70.** Remember, the maximum size opening which is likely to restock naturally is about four to five times tree height.

71

**71.** On south slopes, openings should be smaller — about two or three times tree height. If larger openings are cut, the area beyond seeding distance must be planted.

**72.** Thus far we have reviewed clearcutting methods which can be used in lodgepole pine. Several different partial cutting methods are possible in lodgepole forests. In mixed lodgepole stands and to a lesser degree in pure pine stands, *first* determine if there is an acceptable stand of advanced reproduction, and then if you will manage the stand afterwards.

# PARTIAL CUTTING

73

**In Stands Without Manageable Stand of Advanced Reproduction:**

**use SHELTERWOOD CUT**

74

**In Stands With Manageable Stand of Advanced Reproduction:**

**use SIMULATED SHELTERWOOD**

75

**Stands With Natural Openings or That Require Small Openings:**

**use GROUP SELECTION**

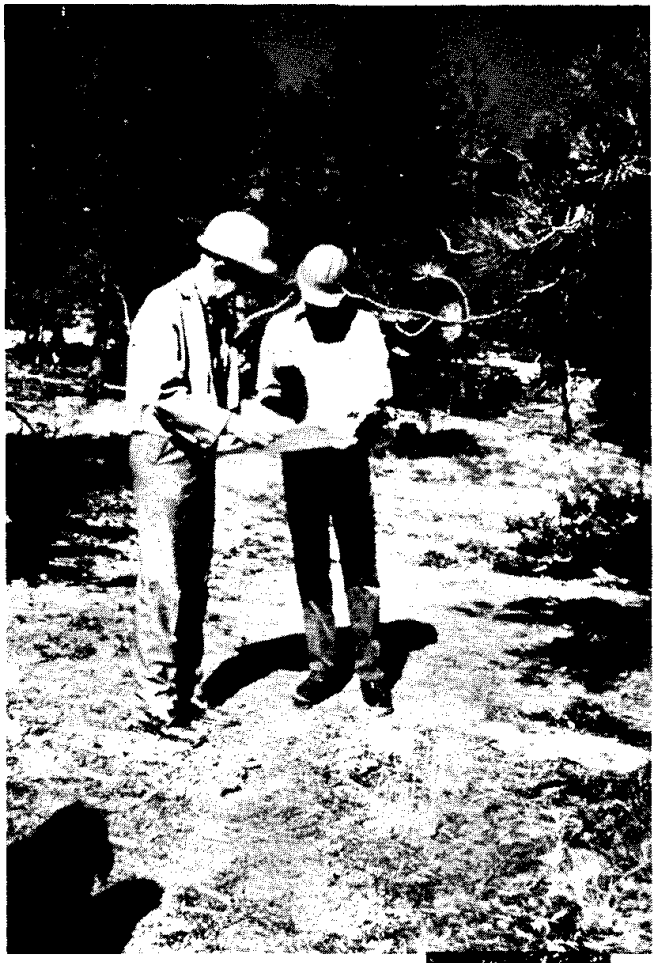
**73.** Where partial cutting must be used in stands *without* a manageable stand of advanced reproduction, use a shelterwood cut.

**74.** If there *is* a manageable stand of advanced reproduction, a simulated shelterwood can be used. Remember from the overview slide talk that a simulated shelterwood is an overstory removal, cut to release a naturally occurring stand of manageable reproduction already existing on the site.

**75.** Stands with natural openings or those stands that require small openings usually favor a group selection cut. Such stands are typically found in areas with a frequent fire history, or mixed with other species.

**76.** Group selection is done in a series of entries throughout the rotation. You'll be able to determine the percentage of basal area to remove in the first entry by evaluating stand condition, windfall risk and insect and disease problems.

76



77

**77.** No matter what method is used — shelterwood, simulated shelterwood, or group selection — partial cutting requires that you carefully mark individual trees or groups of trees, and that you closely supervise logging.

**78.** Finally, after the final harvest and slash disposal, you should reevaluate the reproduction to determine if additional restocking is necessary.

78

# CUTTING RESTRICTIONS

79

**79.** As you have seen, each stand has its own characteristics. It's important to remember that the guidelines just discussed are general. Other factors, at times, will make it necessary to modify your chosen cutting method.

## Mistletoe Infestations

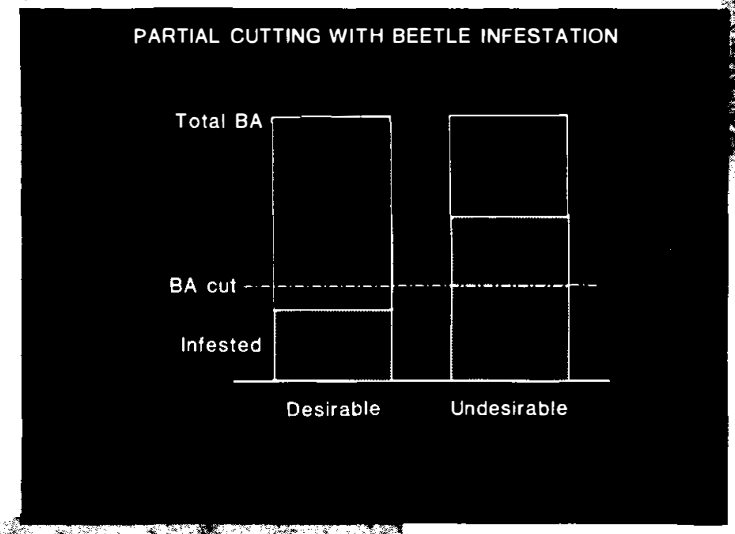
80

**80.** For example, you should partially cut only those stands with a mistletoe rating of two or less (Alexander 1974, Hawksworth 1961). Remove as many infected trees as possible. If a lighter partial cut has to be made for any reason, the first cut should be heavy enough to be a regeneration cut . . . that is establish a new stand. Then, all infected trees left standing must be removed within 10 years after the first cut.

# Bark Beetle Infestations

81

82




**81.** Stands infested with bark beetles pose different restrictions (McCambridge 1979, Cole and Amman 1969, Roe and Amman 1970), if the stand is lightly infected.

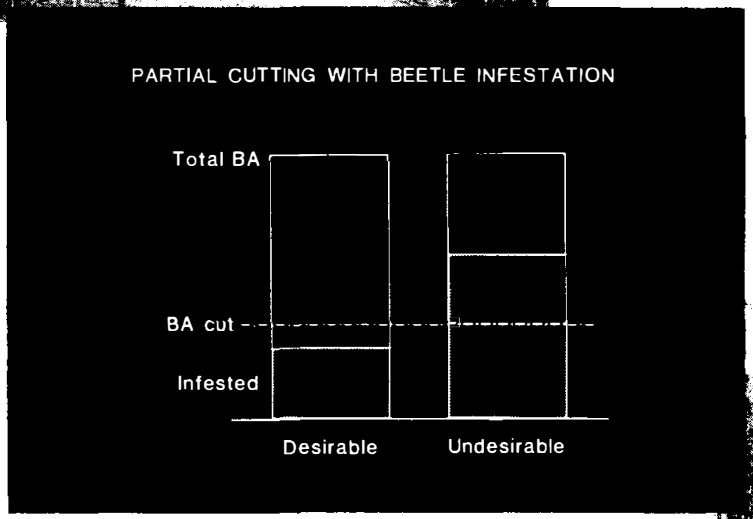
**82.** All attacked trees can be removed in a partial cut without exceeding the recommended basal area to be removed, as shown on the left.

83

**83.** However, if the attack is quite heavy, you have three options . . .

**84.** . . . either remove all attacked trees, or remove the recommended basal area and accept the risk of future loss, or leave the stand uncut.

**85.** If clearcutting is unacceptable, partial cutting or leaving stands uncut where an infestation is building up, will risk an outbreak that may destroy most of the marketable trees in the stand and then spread to nearby stands.

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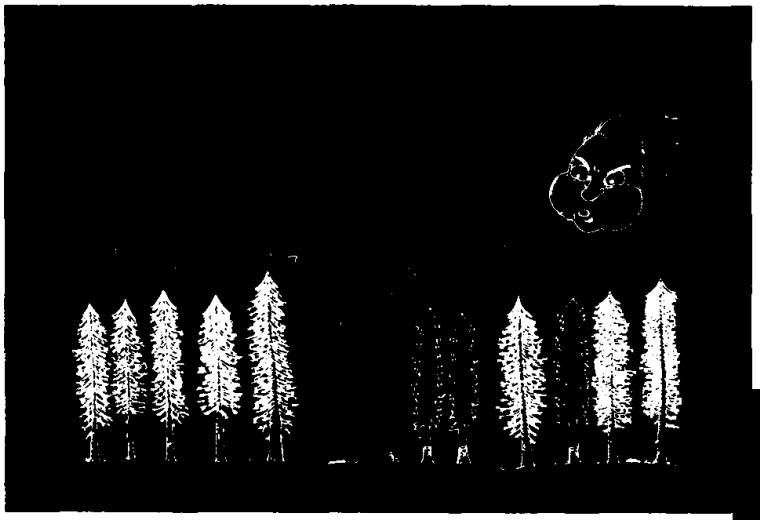
# High Windrisk



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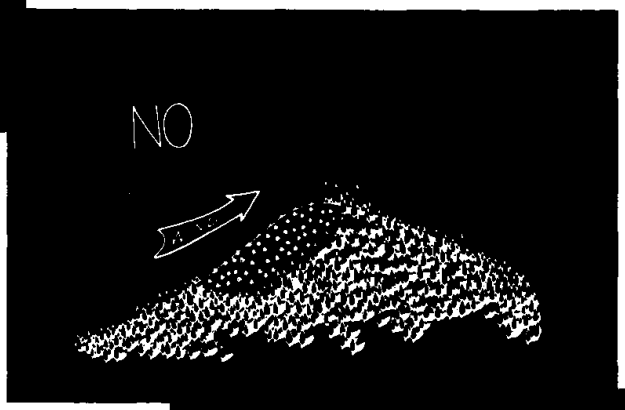
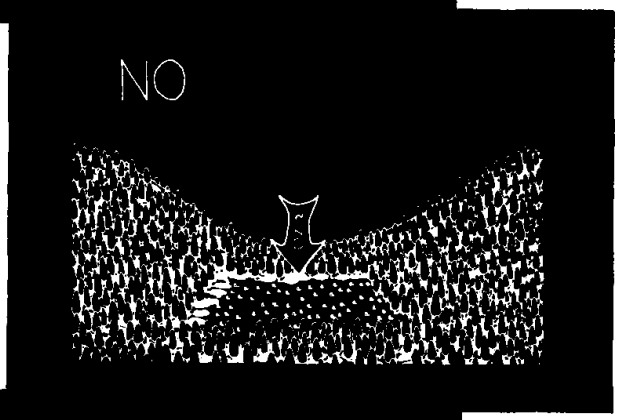



87

**86.** In high wind risk areas, marking guidelines also need to be adjusted (Alexander 1964, 1967, 1974). In irregular stands with small openings, mark trees for removal on the windward edge, not the leeward where they have become windfirm. For example, trees have been removed from the right side of the opening in this illustration.

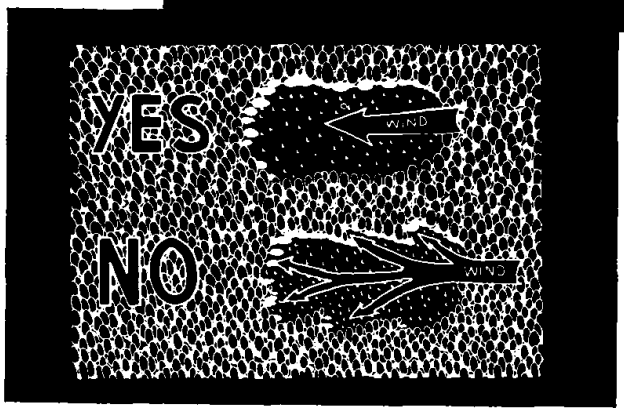
**87.** There are many topographic and stand conditions that you need to consider when marking in high wind risk areas. To avoid blowdown along margins of clearcuts, plan unit layout carefully to protect leeward boundaries from wind. First, avoid locating cutting units on ridgetops . . .




88

**88.** . . . or near saddles where topography can accelerate the force of the wind.

**89.** Using irregular cutting boundaries without sharp corners or wind-catching indentations will also help reduce blowdown.

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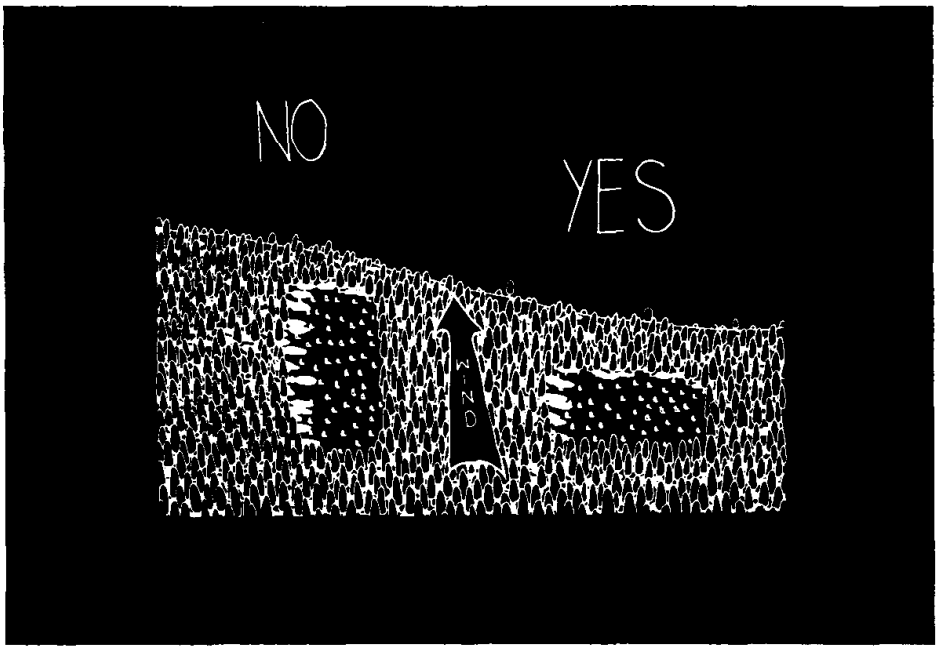


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**90.** Layout each unit so that the maximum cutting boundary is parallel to the contour of the land. This will not only avoid long upslope exposure to the wind, but will usually be more economical to log as well.

**91.** Finally, be sure to avoid poorly drained or shallow soil, and place unit boundaries in stands of sound trees, immature stands or poorly stocked stands which are naturally more windfirm.

# CONCLUSION

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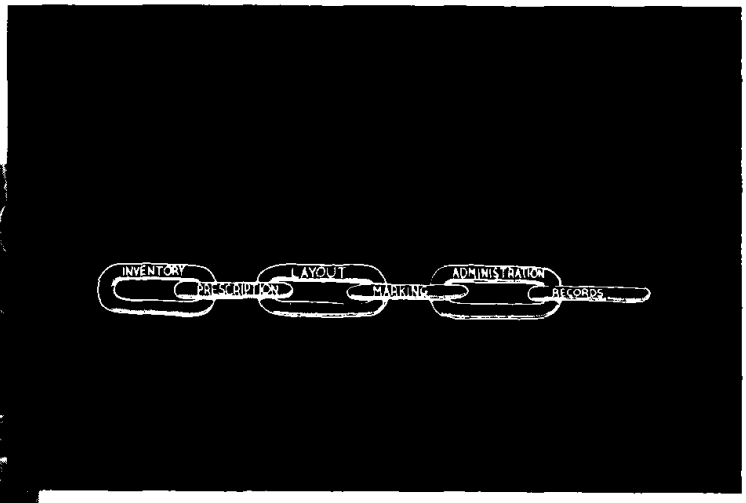


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95

**92.** As you've seen throughout this program, there are many operations crucial to successful silvicultural treatments. A breakdown, or failure of any, will result in the failure of the entire process.

**93.** An accurate prescription is not possible without accurate inventory information. Your best management plan will be ineffective if improperly applied.

**94.** Sale layout and marking personnel need to fully understand the intentions of your prescription to apply it properly. Timber sale administrators have to insure that logging activities can and do meet the prescription requirements.

**95.** Finally, accurate, long term records need to be kept to insure that future activities within the stand are consistent with your original prescriptions and that activities are properly scheduled.

**96.** Proper management is possible only if every member of your management team works together.

96

97

**97.** This program is one of a series giving the state of the art in silviculture of timber species in the Central Rocky Mountains. You may obtain other slide programs in this series, or publications dealing with these subjects, by contacting the Headquarters of the U.S. Forest Service Rocky Mountain Forest and Range Experiment Station in Fort Collins, Colorado.

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